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armored dinosaurs from the Hell Creek Beds of Montana. The material, however, upon which he bases his restoration was scanty—too scanty to serve as a satisfactory basis for a restoration—consisting of the skull, a number of vertebrae, a somewhat problematical scapula, and a number of dermal scutes. The dangers of such attempted restorations as the present one on such imperfect material are apparent here, since *Ankylosaurus* is either very closely allied to or identical with *Stegopelta* Williston, a genus overlooked by Mr. Brown. And *Stegopelta*, which is represented by considerable material in the University of Chicago collections, is as closely allied as well may be with *Polacanthus* Hulke of England, and must go in the same family. A comparison of Nopsca's restoration of *Polacanthus*, which is essentially correct, save for the skull, will show the real form of *Ankylosaurus*, very different from that given by Mr. Brown. *Stegopelta*, moreover, has spines, and the body is covered in large part by small scutes, though there are also large ones, as figured by Mr. Brown; and the tail rings are correctly placed by Brown. The writer has examined the specimen in the British Museum, and is assured of the relationships. *Stegopelta* will shortly be more fully described and figured by Dr. Moodie.

S. W. WILLISTON.

PARASITOLOGY

The Evolution of Parasitism.—In a recent paper entitled: "The Influence of Symbiosis upon the Pathogenicity of Microorganisms (The Evolution of Parasitism)," Musgrave¹ has brought together some most important items in an extremely suggestive manner. He defines symbiosis as representing all phases of association between living organisms, beginning with commensalism, on the one hand, and including true parasitism, on the other, in which either component is influenced in nutrition, metabolism, production or in some other manner by the presence of the other. While this use of the term is distinctly new and rather at variance with the older usage of van Beneden the meaning of the author is clear. He endeavors to show that symbiotic combinations between microorganisms are responsible for uninterpreted phenomena in the etiology and pathology of disease. Furthermore, he adduces evidence to show that changes in symbiosis may produce changes in metabolism and also, as a result of this,

¹ *Philippine Jour. Sc.*, B 3: 78.

changes in the pathogenic character of parasites and in the susceptibility of hosts. The work of other authors is cited indicating the influence that surroundings have on cultures of bacteria even under experimental conditions and leading to the conclusion that the relation between nutrition, metabolism and production is far more significant than has heretofore been considered in laboratory technique. If such influences modify artificial cultures, there will surely be a much greater effect from the complex conditions surrounding mixed cultures in unknown symbiosis.

Among animal parasites nutrition, metabolism and production certainly are more complicated than with bacteria, and unless this fact is constantly in mind the whole subject of parasitism is apt to be considered along too narrow lines and our specificities to be regarded as too exacting. The question, just as with bacteria, not only involves a study of the interaction between an animal host and animal parasites, but a study of host under constantly varying conditions being acted upon by parasites influenced by an ever-changing environment. A battle, as it were, takes place between two sets of very complex influences, leading to death or disease of the host on the one hand, to destruction or commensalism on the part of the parasite on the other, or finally quite frequently to what Theobald Smith has called a condition of balanced parasitism.

Most suggestive in this direction is the experimental work which has been done with amoeba. Chief among the investigators are Musgrave and Clegg, who found that the cultivation of amoeba could not be accomplished satisfactorily except in the presence of other living organisms, and this symbiosis is more or less specific although its specific character may be changed both experimentally and probably also under natural conditions.

The author sums up his paper as follows:

"I am convinced that such an evolution of parasitism from an amoebic and bacterial symbiosis, in water or elsewhere in nature, through a beginning or mixed tissue and bacterial parasitism in amoebic ulcers of the colon, to a true tissue parasitism in the internal organs of the body, or even to a blood invasion itself, is a matter of frequent occurrence. The most promising field for laboratory research in the future will be the study of cause and effect, in the complex relations in which they occur in nature, of the interrelation and interaction of micro-organisms with each other and in their environment of complex symbiosis and the ever-changing and multiple conditions found in hosts."